How to view Galileo transformation and Lorentz transformation from a higher level

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Abstract: The Galilean transformation and the Lorentz transformation can both be seen as incomplete expressions under a certain equation.

Key words: Galileo transformation, Lorentz transformation, inertia.

Galilean transformation: $\begin{cases}\left(x'\right) = (x - vt)\\ \left(t'\right) = (\mathrm{t})\end{cases}$.

Lorentz transformation: $\begin{cases}\left(x'\right) = \frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^2}}(x - vt)\\ \left(t'\right) = \frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^2}}\left(t - \frac{v}{c^2}x\right)\end{cases}$.

And the connection between them is: $\begin{cases}x' = x - vt\\ t' = t\end{cases} \Leftrightarrow \begin{cases}\left(x' - vt\right) = (x - vt)\\ \left(t' + \frac{vt't}{x'}\right) = \left(t + \frac{vt't}{x'}\right)\end{cases}$,

$$\Leftrightarrow \begin{cases}\left(x' - vt\right) = (x - vt)\\ \left(t' + \frac{vt't}{x'}\right) = \left(t - \frac{vt'}{ic}\right)\end{cases} \Leftrightarrow \begin{cases}\left(x' - \frac{vix'}{c}\right) = (x - vt)\\ \left(t' + \frac{vt't}{x'}\right) = \left(t - \frac{v}{c^2}x\right)\end{cases},$$

$$\Leftrightarrow \begin{cases}\left(x' - \frac{vix'}{c}\right) = (x - vt)\\ \left(t' - \frac{vt'}{ic}\right) = \left(t - \frac{v}{c^2}x\right)\end{cases} \Leftrightarrow \begin{cases}\left(x' - \frac{vix'}{c}\right)^2 = (x - vt)^2\\ \left(t' - \frac{vt'}{ic}\right)^2 = \left(t - \frac{v}{c^2}x\right)^2\end{cases},$$

$$\Leftrightarrow \begin{cases}\left(x'\right)^2 + \left(\frac{vix'}{c}\right)^2 - 2\frac{vi\left(x'\right)^2}{c} = (x - vt)^2\\ \left(t'\right)^2 + \left(\frac{vt'}{ic}\right)^2 - 2\frac{v\left(t'\right)^2}{ic} = \left(t - \frac{v}{c^2}x\right)^2\end{cases} \Leftrightarrow \begin{cases}\left(x'\right)^2 - \left(\frac{vx'}{c}\right)^2 = (x - vt)^2\\ \left(t'\right)^2 - \left(\frac{vt'}{c}\right)^2 = \left(t - \frac{v}{c^2}x\right)^2\end{cases},$$

$$\Leftrightarrow \begin{cases}\left(x'\right)^2\left[1 - \left(\frac{v}{c}\right)^2\right] = (x - vt)^2\\ \left(t'\right)^2\left[1 - \left(\frac{v}{c}\right)^2\right] = \left(t - \frac{v}{c^2}x\right)^2\end{cases} \Leftrightarrow \begin{cases}\left(x'\right) = \frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^2}}(x - vt)\\ \left(t'\right) = \frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^2}}\left(t - \frac{v}{c^2}x\right)\end{cases}.$$

Reference: none.